

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT(S): Jammy et al. Examiner: Michelle Estrada
SERIAL NO.: 09/363,523 Group Art Unit: 2823
FILED: July 29, 1999 Dated: February 18, 2003
FOR: METHOD FOR FORMING CRYSTALLINE SILICON NITRIDE

Assistant Commissioner for Patents
Washington, DC 20231

BOX AF

AMENDMENT TRANSMITTAL FORM

Sir:

Transmitted herewith is an amendment in the above-identified application.

- ☐ Small entity status of this application under 37 C.F.R. §§1.9 and 1.27 has been established by a verified statement previously submitted.
- ☐ A verified statement to establish small entity under 37 C.F.R. §§1.9 and 1.27 is enclosed.
- ☒ No additional fee is required.

For	Claims Remaining After Amendment	Highest No. Previously Paid For	Present Extra	Rate (Small Entity)	Addit. Fee	Rate	Addit. Fee
TOTAL CLAIMS*	20	20	0	x 9 =	\$0	x 18 =	\$0
INDEPENDENT CLAIMS	3	3	0	x 42	\$0	x 84 =	\$0
<input type="checkbox"/> First Presentation of Multiple Dep. Claim				140		280	\$0

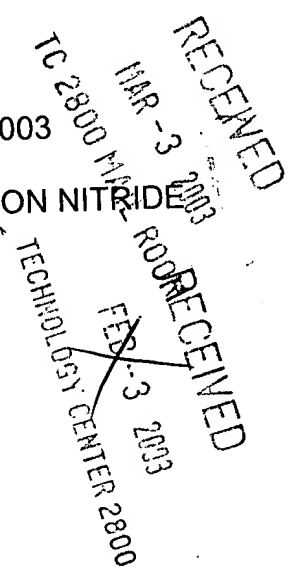
* If the entry in Col. 1 is less than entry in Col. 2, write "0" in Col. 3.
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Dated: February 18, 2003


Frank V. DeRosa



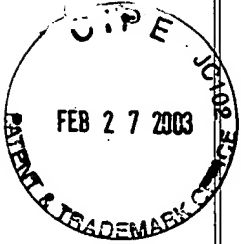
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- ☒ Please charge any deficiency as well as any other fee(s) which may become due under 37 C.F.R. §§1.16 and/or 1.17 at any time during the pendency of this application, or credit any overpayment of such fee(s) to Deposit Account No. 50-0679. Also, in the event any extensions of time for responding are required for the pending application(s), please treat this paper as a petition to extend the time as required and charge Deposit Account No. 50-0679 therefor. TWO (2) COPIES OF THIS SHEET ARE ENCLOSED.

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Respectfully submitted,



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RESPONSE UNDER 37 C.F.R. § 1.116
-EXPEDITED PROCEDURE-
EXAMINING GROUP ART UNIT 2823

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Jammy et al.

Examiner: Estrada, Michelle

Serial No: 09/363,523

Group Art Unit: 2823

Filed: July 29, 1999

Docket: 8055-98 (99-P-7722-US)

For: **METHOD FOR FORMING CRYSTALLINE SILICON NITRIDE**

BOX AF

Commissioner of Patents
Washington, D.C. 20231

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RESPONSE

This is a response to the Final Office Action mailed on December 16, 2002. Claims 1-8, 10-16 and claims 21-28 are pending in the application.

Claims 1-8 and 21-28 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Thakur et al. (US 5,913,149) in combination with Schachameyer et al. (US 4,940,505) and further in view of Ho et al. (US 5,643,823).

Claims 10-16 stand rejected under 35 U.S.C. §103(a) over Thakur in combination with Schachameyer and further in view of Ho as applied to claims 1-8 and 21-28, and further in view of Wolf, Vol. 2. Applicants respectfully traverse the rejections and request reconsideration of the

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Dated: 2/18/03


Frank DeRosa

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claim rejections based on the following remarks.

It is respectfully submitted that at the very minimum, the combination of Thakur, Schachameyer and Ho fails to establish a prima facie case of obviousness against claims 1 and 21 because the combination does not disclose or suggest growing a crystalline silicon nitride layer, as essentially claimed in claims 1 and 21. Indeed, Applicants respectfully disagree with the contention that Thakur discloses (Col. 1, lines 60-62) forming a continuous crystalline silicon nitride layer (element 20, Fig. 3) as contended on page 2 and 5 of the Final Office Action. Although Thakur discloses a silicon nitride layer (20), it is abundantly clear to one of ordinary skill in the art that the process disclosed by Thakur in forming layer (20) does not form a crystalline silicon nitride layer.

In particular, Thakur discloses (Col. 1, lines 61-62, Col. 5, lines 14-30) that the silicon nitride layer (20) is formed using a RTN process. Thakur acknowledges that a RTN process results in dielectrics that "lack uniformity in their overall composition." (Col. 1, lines 65-66). In other words, RTN produces a dielectric layer with a non-crystalline structure.

Further, Applicants specification (page 7, lines 5-9) teaches that the formation of silicon nitride using a combination of thermal growing (in N₂ and NH₃) and/or deposited with LPCVD results in amorphous silicon nitride. Thus, the process of Thakur (as disclosed in Col. 5, lines 15-30) which uses thermal growing with LPCVD, clearly results in a non-crystalline silicon nitride layer. Thus, Thakur does not disclose a process for forming a crystalline silicon nitride layer.

Applicants respectfully disagree with Examiner's contention on page 2 of the Final Office Action that Thakur discloses forming the silicon nitride layer at a temperature range that overlaps that of the present invention and under the same conditions, so the recited results would be

obtained. Indeed, Applicants specification teaches that continuous crystalline layer is formed under certain conditions including an H₂ prebake and nitridation, and wherein a certain amount of time elapses between the cleaning step and the H₂ prebake step. (Page 11, line 10- Page 12, line 19). Therefore, although Thakur teaches nitridation using NH₃ at a certain temperature, without at least an H₂ prebake, the Thakur process does not result in forming a crystalline silicone layer.

Although, Schachameyer arguably teaches using an H₂ prebake, Schachameyer is directed to a method of growing a silicon crystalline layer, not a process for growing a silicon nitride layer. Thus, there is no motivation to combine Thakur and Schachameyer. It is respectfully submitted the Examiner's contention that there is motivation to combine Thakur and Schachameyer because Schachameyer "provides additional cleaning in order to avoid operator error" misses the point. Indeed, as noted, e.g. on pages 11-12 of Applicants' specification, the H₂ prebake together with elapsed time between cleaning and prebake enables formation of the crystalline silicon nitride layer when subsequently growing the silicon nitride layer. Thus, there is simply no teaching in Schachameyer that would suggest to one of ordinary skill in the art that cleaning, followed by H₂ prebake after a certain time, would enable the growth of a crystalline silicon nitride layer.

Next, Examiner's contention that Thakur teaches forming a crystalline silicon nitride layer because the "temperature range of Ho overlaps with the temperature range of Thakur is misplaced. Indeed, Ho discloses a method of forming a largely crystalline silicon nitride layer by first depositing an amorphous silicon nitride film and then annealing the film to cause the amorphous layer to become largely crystallized (Col. 2, lines 55-66). The process of Ho is

entirely different than the Thakur process which involves growing the silicon nitride layer in situ via a nitrogen gas. There is a significant difference between the Ho process of depositing an amorphous layer and then annealing to generate a crystalline structure, as opposed to the Thakur process of growing a non-crystalline structure using nitridation, even if the temperature ranges of Ho and Thakur overlap. Thus, Ho does not support the conclusion that Thakur discloses forming a crystalline silicon nitride layer.

Therefore for at least the above reasons, claims 1 and 21 are believed to be patentable and nonobvious over the combination of Thakur, Schachameyer and Ho. Claims 2- 8 depend from independent claim 1, and claims 22-28 depend from independent claim 21. Thus, these claims are allowable for at least the same reasons given for their respective base claims 1 or 21.

Applicants respectfully submit that, at the very minimum, claim 10 is patentable and nonobvious over such combination distinct for at least the reasons as stated above for claims 1 and 21. Indeed, claim 10 recites, *inter alia*, "...precleaning the exposed surfaces by employing hydrogen prebake after an amount of time has elapsed after the removal step...to grow a continuous crystalline silicon nitride layer..."

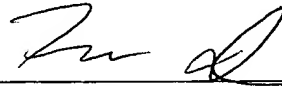
Further, Wolf does not cure the deficiencies of Thakur and Schachameyer. Namely, Wolf does not teach or disclose "to grow a continuous crystalline silicon nitride layer," nor does Examiner contend so. Thus, the combination of Thakur, Schachameyer, Ho and Wolf does not render claim 10 obvious.

Claims 11-16 depend from independent claim 10, and are, thus are allowable for the same reasons given for claim 10.

In view of the foregoing remarks and amendments, it is respectfully submitted that all the

claims now pending in the application are in condition for allowance. Early and favorable reconsideration of the case is respectfully requested.

Respectfully submitted,



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